

Effects of Verb Bias and Syntactic Ambiguity on Reading in People with Aphasia

People with aphasia (PWA) often have sentence comprehension impairments. According to the Lexical Bias Hypothesis, these impairments emerge when a verb's argument structure biases conflict with the sentence structure (Gahl, 2002). For example, PWA had more trouble understanding sentences in which the verb's transitivity bias conflicted with the sentence structure (e.g., a transitively biased verb in an intransitive sentence) (Gahl, 2002). The present study tested the Lexical Bias Hypothesis by investigating whether PWA use verb bias differently from non-brain-damaged controls when reading syntactically ambiguous and unambiguous sentences like those in examples (1) and (2).

1. The talented photographer| accepted| (that)| the fire| could not| have been| prevented.
2. The ticket agent| admitted| (that)| the airplane| had been| late| taking off.

Sentences (1) and (2) contain a sentential complement (underlined). The structure is unambiguous when the sentential complement (SC) is introduced by the pronoun “*that*,” and ambiguous when “*that*” is omitted. In the ambiguous condition, the noun phrase following the main verb (e.g., *the fire*) could be interpreted as the direct object (DO) of the main verb or the subject of a SC. The embedded verb is the point in the sentence at which the correct interpretation becomes clear, known as disambiguation. Sentences 1 and 2 differ with respect to the bias of the main verb. The main verb is biased to take a DO in sentence 1 (e.g., *accepted*), but biased to take a SC in sentence (2) (e.g., *admitted*). Garnsey et al. (1997) showed that both syntactic ambiguity and verb bias influenced reading times for college age adults.

The Lexical Bias Hypothesis predicts that PWA would experience more difficulty processing sentences with sentential complements when they contain DO- versus SC-biased verbs, but it does not generate clear predictions regarding effects of syntactic ambiguity. For controls, the typical ambiguity effect is faster processing times in unambiguous sentences (i.e., when the pronoun “*that*” is present). If PWA use the syntactic cue provided by “*that*” in the same way as controls, then they should show typical ambiguity effects. However, previous research indicates that PWA may have trouble processing syntactic cues from function words such as “*that*” (e.g., Rosenberg et al., 1985; ter Keurs et al., 2002). If PWA have difficulty using syntactic cues that are communicated by function words, they might rely on cues such as verb bias to a greater extent than controls.

METHODS

Participants: Nine PWA (mean= 49 years) and ten non-brain-damaged controls (mean= 50 years) participated. The PWA completed background testing to characterize their aphasia and ensure adequate word comprehension to complete the tasks.

Stimuli: The stimuli were a subset of those used in Garnsey et al. (1997) (sentences 1 & 2). All of the sentences contained sentential complements. The main verb was biased to take a DO or SC (n=16 per condition). All sentences occurred both with and without the relative clause pronoun “*that*.” The noun phrase that followed the main verb was always implausible as the direct object of the main verb. Each item was followed by a comprehension question.

Task: On-line written sentence processing was measured using self-paced reading. The stimuli were divided into segments as shown in the example sentences. Each trial began with a

series of dashes (-) marking the length and position of the words in the sentence. The participants pressed a button to reveal each segment. When they pressed the button, the previously revealed segment reverted to dashes and the next segment was revealed. The button box collected accuracy and reaction times for each button press.

Procedures: The stimuli were divided into 2 lists so unambiguous and ambiguous versions of the same sentences were separated. All participants completed both lists in separate testing sessions, which were at least 7 days apart.

RESULTS

The independent variables were group (PWA vs. control), verb bias (DO vs. SC), and ambiguity (presence vs. absence of *that*).

Comprehension Questions (Figure 1): The PWA made more errors than controls, $F(1,17)=29.8$, $p<.0001$, $F(1,30)=227.8$, $p<.0001$. Both the main effect of ambiguity and the ambiguity by group interaction were significant in analyses by participants [*ambiguity*: $F(1,17)=5.95$, $p=.03$, $F(1,30)=2.82$, $p=.10$; *ambiguity x group*: $F(1,17)=4.32$, $p=.053$, $F(1,30)=4.32$, $p=.053$, $F(1,30)=4.32$, $p=.053$, $F(1,30)=4.32$, $p=.053$]. Both groups made more errors about sentences in the ambiguous condition, but the ambiguity effect was numerically greater in PWA.

Reading times (Figure 2): Residual reading times (RTs) were analyzed to control for differences in segment length. The critical segments (ambiguous noun phrase and disambiguating region) are bolded in (1) and (2).

Control group: RTs were longer in ambiguous than unambiguous sentences at both critical segments (*ambiguous*: $F(1,9)=11.1$, $p=.01$, $F(1,30)=26.3$, $p<.0001$; *disambiguation*: $F(1,9)=9.88$, $p=.01$, $F(1,30)=3.47$, $p=.07$). The ambiguity effect was numerically larger in sentences with DO-biased verbs, but the interaction was not significant.

PWA: For the ambiguous segment, the interaction between ambiguity and verb bias was significant by participants, $F(1, 8)=9.35$, $p=.02$, $F(1,26)=2.21$, $p=.16$. The RTs were numerically longer for ambiguous than unambiguous sentences in the DO-bias, but not SC-bias, condition.

PWA read the disambiguating segment more slowly in sentences with DO- than SC-bias verbs, $F(1,9)=66.25$, $p<.001$, $F(1,26)=8.76$, $p<.01$. Although the effect of verb bias was numerically larger in ambiguous sentences, the same pattern was present in unambiguous sentences.

Individual Analyses: Inspection of the individual cases revealed that seven of the nine participants with aphasia showed a larger effect of verb bias than ambiguity. Bayesian Standardized Difference tests indicated that four of the seven showed a significantly greater difference than would be expected based on the normative group. The remaining two participants showed the same pattern as the control group, which was a larger effect of ambiguity than verb bias.

DISCUSSION

The results were consistent with the Lexical Bias Hypothesis. For PWA, the primary determinant of processing difficulty appeared to be verb bias. In contrast, the presence or absence of the pronoun “*that*” appeared to be the primary determinant of processing difficulty for controls. However, the comprehension and RT data suggested that PWA were also sensitive

to the presence or absence of the pronoun “that.” Taken together, the results suggest that PWA were aware of the structural cue provided by the pronoun “that,” but relied on verb bias to a greater extent. This over-reliance on verb bias in PWA may be due to delayed or reduced processing of closed-class words (e.g., ter Keurs et al., 2002).

REFERENCES

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FIGURES

Figure 1: Proportion Correct

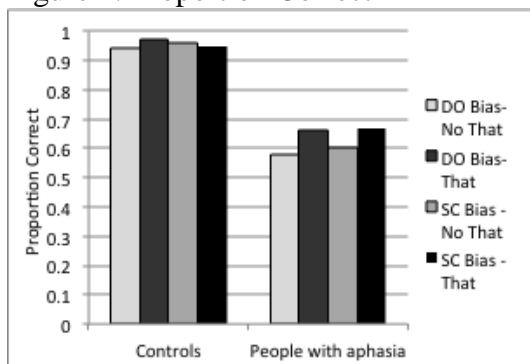


Figure 2: Residual Reading Times (controlled for segment length) for Critical Segments.

